IMI Descriptions of Fungi and Bacteria No. 2220

MERIDERMA ECHINULATUM

A. Sporocarps (bar = 1 mm). **B**. Capillitium and spores (bar = 20 µm). [Photographs: A. Michaud]

Meriderma echinulatum (Meyl.) Mar. Mey. & Poulain, in M. POULAIN, M. MEYER & J. BOZONNET, *Les Myxomycètes* Sevrier **1**: 551 (2011). [*IndexFungorum* 548430; *Incertae sedis*, *Mycetozoa*]

Lamproderma atrosporum var. *echinulatum* Meyl., *Bulletin de la Société Vaudoise de Sciences Naturelles* **57**(no. 228): 368 (1931) [publ. 1932]. [*IndexFungorum* 548435]

Lamproderma atrosporum var. *macrosporum* Meyl., *Bulletin de la Société Vaudoise de Sciences Naturelles* **57**(no. 228): 368 (1931) [publ. 1932]. [*IndexFungorum* 257784]

Meriderma echinulatum var. *macrosporum* (Meyl.) Mar. Mey. & Poulain, in M. POULAIN, M. MEYER & J. BOZONNET, *Les Myxomycètes*: 551 (2011). [*IndexFungorum* 548431]

Diagnostic features. Sporocarps sessile or sometimes short-stalked sporangia; peridium usually fragmented or entirely absent; capillitium with funnel-shaped ends (such funnels absent from *Lamproderma*), sometimes with small peridial fragments adhering to the funnels; spores *en masse* black, with irregular ornamentation of long spines.

On natural substratum. *Amoebal state* no information. *Plasmodium* no information. *Hypothallus* brown. *Sporocarps* sessile or sometimes short-stalked sporangia, usually crowded in compact groups, 1·4–1·7 mm high. *Stalks* no information (the generic circumscription describes stalks, when present, as longitudinally furrowed and black). *Sporotheca* obovoid or prolate, ± oblong, 1·4 × 0·9–1·2 mm, dark brown, almost black. *Peridium* conspicuous only in fresh material, fugacious, fragmenting into small scales. *Columella* reaching the centre of the sporotheca. *Capillitium* dark, arising from the length of columella, the tips expanded into funnel-shaped expansions at the junction with the peridium, small peridial fragments often adhering to those funnels. *Spores en masse* black, individually dark fuscous brown, 10–17(–19) µm diam., echinulate, sometimes connected by ridges, with irregularly distributed ornamentation.

ASSOCIATED ORGANISMS & SUBSTRATA: **Plantae**. *Acer* sp.; *Alnus* sp. (stem); *Arctostaphylos nevadensis* A. Gray (leaf); *Fagus sylvatica* L. (stem); *Gramineae* indet.; *Muscopsida* indet.; *Rhododendron* sp. (leaf); *Rubus* sp. (stem); *Vaccinium myrtillus* L. (stem, twig), *Vaccinium* sp. (shoot). **Associated organism of type specimen**. None cited. **Comment**. This species occurs on dead, sometimes dry, leaves, living and dead stems, and twigs of various angiosperms and gymnosperms.

INTERACTIONS & HABITATS: For a thorough introduction to myxomycete ecology, see MADELIN (1984). The dead plant material with which myxomycetes are very widely associated, while undoubtedly a platform for their sporocarps, is not necessarily a source of nutrition. Sporocarps are the only stage in myxomycete life cycles where species can be identified by morphology. The other states, as amoebae and plasmodia, have received little attention. SHCHEPIN *et al.* (2019) suggested that populations of myxomycete amoebae may inhabit much wider ecological niches than indicated by records of their sporocarps. Specific information about the ecology and nutrition of the amoebal state of *M. echinulatum* is now starting to emerge (BORG DAHL, 2018). In their amoebal state, myxomycetes are known to feed on small organic particles and micro-organisms (including some fungi), but the identity of those micro-organisms is rarely, if ever, recorded. This species is nivicolous, apparently obligately so (JANIK & RONIKIER, 2016), found in spring near melting snow, and is thus associated with alpine and other montane ecosystems. Although associations with animals, fungi and micro-organisms are known or suspected, no observations were found where the associated organism was identified to genus or species level.

GEOGRAPHICAL DISTRIBUTION: NORTH AMERICA: USA (California). ASIA: Japan. EUROPE: Austria, France, Germany, Greece [*http://greekmyxomycetes.blogspot.com/2014/08*, accessed 17 November 2019], Italy, Norway, Poland, Russia (Karachay-Cherkess Republic, Leningrad Oblast), Ukraine. **Elevation (m above sea level)**. Records up to 2440 (Russia: Karachay-Cherkess Republic). **Comment**. Native to mountainous areas of Europe and North America.

ECONOMIC IMPACTS: There is experimental evidence that this species can accumulate heavy metals (KRYVOMAZ, 2015*a*, *b*; KRYVOMAZ & ANDRUSISHINA, 2015; KRYVOMAZ *et al.*, 2016; KRYVOMAZ, 2017*a*, *b*; KRYVOMAZ *et al.*, 2017). KRYVOMAZ (2017*a*) measured metal levels in samples of *M. echinulatum*. The levels of different elements were, in descending order, as follows [µg of metal per g of myxomycete tissue]: Ca (13666·7), Fe (4666·7), Mg (2966·7), Si (1833·3), Mn (1753·3), Al (1600), Pb (210), Zn (126·67), Ni (76·7), Cu (8), Cd (6), Cr (2). Like many other nivicolous species, *M. echinulatum* strongly accumulated the highly toxic heavy metals Cd and Pb. It also accumulated the moderately toxic heavy metals Ni and Fe. Such properties are likely to have significant positive economic potential (STEPHENSON & MCQUATTIE, 2000). Although nothing has yet been developed for the present species, there is considerable interest in use of fungi with similar abilities for bioremediation and other applications (GADD, 2007). No evaluation has been made of any other possible positive economic impact of this organism (e.g. as a recycler, as a source of useful products, as a provider of checks and balances within its ecosystem, etc.). No reports of negative economic impacts have been found.

INFRASPECIFIC VARIATION: The two varieties, listed in the synonymy above, are distinguished by spore size: *M. echinulatum* var. *echinulatum* has spores 10–13(–15) µm diam.; *M. echinulatum* var. *macrosporum* has spores 14–17(–19) µm diam. (POULAIN *et al.*, 2011).

DISPERSAL & TRANSMISSION: For a general discussion about myxomycete dispersal, see KRYVOMAZ & STEPHENSON (2017). Myxomycete spores are dispersed considerable distances by wind. Field experiments and mathematical modeling have shown that, with winds of 0·1 m/s, spores can travel up to *c.* 1·8 km, and when wind speed reaches 28 m/s, this rises to over 500 km (TESMER & SCHNITTLER, 2007). Spores and myxamoebae may be dispersed by rainwater, meltwater and water in soil. Some local dispersal may also occur by movement of myxamoebae and plasmodia. Insects and other invertebrates feed on sporophores, as probably do terrestrial vertebrates including birds, and myxomycete spores have been found in insect faeces, suggesting that animals may play a part in their dispersal. For some species (but probably very rarely or never nivicolous myxomycetes), plant debris floating in seawater may also contribute to dispersal between land masses.

CONSERVATION STATUS: The IUCN's Red Listing Criteria were originally designed for evaluation of vertebrate animals and flowering plants, and present challenges to those trying to apply them to organisms like myxomycetes which are unicellular for a significant part of their life cycle. A discussion of those challenges, particularly in respect of myxomycetes and climate change, is provided by KRYVOMAZ & STEPHENSON (2017). **Previous evaluations**. Common in Poland (JANIK & RONIKIER, 2016). **Information base**. About 70 records (specimens, databases and bibliographic sources combined, excluding duplicates) from at least 1931 to May 2018, with observations in March, April, May, June and July. **Estimated extent of occurrence** [calculated using *http://geocat.kew.org*]. Well over 3·8 million km^2 (Asia: insufficient data; Europe: 3·8 million km^2; North America: insufficient data). **Estimated area of occupancy** [calculated using *http://geocat.kew.org*]. Over 160 km^2. The method for estimating area of occupancy has produced an artificially low figure. The species is likely to be under-recorded because of the small number of people with the skills to search for and identify it. Some of the plants with which it is associated are common and widespread species. **Threats**. As an apparently obligate nivicolous species, *M. echinulatum* is likely to be severely threatened by climate change. Insufficient information to enable other threats to be identified. In particular, possible vulnerabilities of the amoebal and plasmodial states of this species are currently completely overlooked. **Population trend**. Not known. Of datable records, *c.* 5% are pre-1961, 35% post-1960 but pre-2001, and 60% post-2000. **Evaluation**. Using IUCN criteria (IUCN SPECIES SURVIVAL COMMISSION. *2006 IUCN Red List of Threatened Species* [*www.iucnredlist.org*]. Downloaded on 15 May 2006), the species is assessed globally as Data Deficient. ***In situ* conservation actions**. None noted. ***Ex situ* conservation actions**. 144 nucleotide sequences, 6 PopSet sequences and 63 protein sequences were found in a search of the NCBI GenBank database [*www.ncbi.nlm.nih.gov*, accessed 11 November 2019]. No living strains of this species are listed by the ATCC, CABI and Westerdijk Institute [formerly CBS] culture collections.

NOTES: NOVOZHILOV *et al.* (2013) and JANIK & RONIKIER (2016) provide scanning electron micrographs of spores of this species. Molecular techniques are now being developed to detect myxomycetes in soil, and this may make it possible to identify species in their amoebal state. *Meriderma echinulatum* was included in one such pioneering study (HOPPE & SCHNITTLER, 2015). Radiation levels in this and several other nivicolous myxomycetes were monitored by KRYVOMAZ (2015*b*), and found not to exceed acceptable levels.

LITERATURE & OTHER SOURCE MATERIAL: BORG DAHL, M. *Exploring the Diversity of Nivicolous Myxomycetes* An Analysis of the Genetic Diversity, Species Distribution and Community Composition. Thesis (Dr Rerum Naturalium), University of Greifswald, Germany: 114 pp. (2018). GADD, G.M. Geomycology: biogeochemical transformations of rocks, minerals, metals and radionuclides by fungi, bioweathering and bioremediation. *Mycological Research* **111**(1): 3-49 (2007). GALLINARI, A. & FERRARI, P. Contributo alla conoscenza dei myxomiceti nivicoli della provincia di Brescia. *Natura Bresciana* **38**: 57-69 (2013). HOPPE, T. & SCHNITTLER, M. Characterization of myxomycetes in two different soils by TRFLP-analysis of partial 18S rRNA gene sequences. *Mycosphere* **6**(2): 216-227 (2015). 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- *National Center for Biotechnology Information* [*www.ncbi.nlm.nih.gov*].
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